HEAT EXCHANGER MODULE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a heat exchanger module, in which at least a first heat exchanger and a second heat exchanger are integrated with each other through brackets, and can be effectively applied to a cooling module in which a radiator for a vehicle and an external heat exchanger of an air conditioner for a vehicle are integrated.

2. Description of the Related Art

Conventionally, a radiator and a condenser are integrated by inserts (side plates) or fins, etc., and mounting brackets for mounting the same to a vehicle are secured to header tank portions (see Japanese Unexamined Patent Publication No. 11-142084, for example).

Before making the radiator and the condenser integral with each other, the radiator and the condenser must be manufactured separately, because the specifications thereof are quite different.

In this regard, according to a prior art disclosed in Japanese Unexamined Patent Publication No. 11-142084, a cooling module in which a radiator has already been integrated with a condenser is mounted in a vehicle through brackets. Thus, it is difficult to apply the prior art to the cooling module in which both of the heat exchangers, i.e., the radiator and the condenser, are integrated with each other after they are manufactured separately.

SUMMARY OF THE INVENTION

In view of the above problem, the present invention is aimed at provision of a structure applicable to a heat exchanger module in which at least two heat exchangers are integrated with each other after they are manufactured separately.

To achieve the above objective, according to the present invention, a heat exchanger module comprises a first heat exchange 1 and a second heat exchanger 2 which are integrated with each other through brackets 3, the first and second heat exchangers 1 and 2 each being constituted by solder-brazing a plurality of tubes and header tanks connected thereto, which are located at opposite ends of the plurality of tubes in the longitudinal direction, wherein the first and second heat exchangers 1 and 2 are arranged with core surfaces thereof being opposed to each other, the brackets 3 are provided with mounting parts 3b for mounting the heat exchangers 1 and 2 to a vehicle, and the brackets 3 are made of resin and located between the heat exchangers 1 and 2.

The brackets 3 made of resin having lower thermal conductivity than a metal are located between the heat exchangers 1 and 2, so that heat transfer, from the heat exchanger on a higher temperature side to the heat exchanger on a lower temperature side, can be restricted.

A predetermined space must be provided between cores of the heat exchanger 1 and 2. According to the present invention, the heat exchangers 1 and 2 are assembled with and secured to the brackets 3 so that, for example, the position of the second heat exchanger 2 with respect to the first heat exchanger 1 can be easily determined. Therefore, the assembling of the heat exchanger module can be facilitated and heat exchange between the first and second heat exchangers 1 and 2 can be restricted, due to a predetermined space provided between the cores of the heat exchangers 1 and 2.

According to the present invention, the bracket 3 has mounting parts 3b and bracket body 3a in the form of a strip plate which is located between a header tank 1d of the first heat exchanger 1 and a header tank 2d of the second heat exchanger 2.

According to the present invention, the mounting

part 3b is provided, on a mounting stay 3c projecting from an end side of the bracket body 3a in the longitudinal direction, in a direction substantially orthogonal to the longitudinal direction of the bracket body 3a. The mounting stay 3c is provided on its root side with a reinforcing part 3d to resist a moment acting on the mounting stay 3c.

Further, according to the present invention, the mounting stay 3c projects from the bracket body 3a toward the core sides of the heat exchangers 1 and 2 and the reinforcing part 3d has through holes 3e extending in a direction orthogonal to the core surface.

As the holes 3e permit the cooling air to pass therethrough, the reinforcing parts 3d, which would otherwise obstruct the cooling air flowing through the core, can enhance the rigidity of the brackets 3 without reducing the cooling efficiency of the heat exchanger module.

According to the present invention, the brackets 3 are located on opposite end sides of the heat exchangers 1 and 2, and at least one of the brackets 3 are secured to the heat exchangers 1 and 2 by pin-shaped securing means 4 extending in a direction orthogonal to the core surface.

Due to this arrangement, if a hole in which the securing means 4 is inserted is larger than the diameter of the securing means 4 or is an elongated hole, a dimensional difference between the heat exchangers 1 and 2 can be easily absorbed, so that the brackets 3 can be easily mounted to the heat exchangers 1 and 2.

Further, according to the present invention, a fan mounting part 3f for mounting a fan, to feed air to the heat exchangers 1 and 2, is provided in the vicinity of the mounting part 3b.

The present invention may be more fully understood from the description of preferred embodiments of the invention, as set forth below, together with the

accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Fig. 1 is a perspective view of a cooling module according to Embodiment 1 of the present invention, viewed from the downstream side of an air flow.

Fig. 2 is a top view of a part "A" in Fig. 1.

Fig. 3 is a front view of a part "A" in Fig. 1.

Fig. 4 is a front view of a bracket according to Embodiment 1 of the present invention.

Fig. 5 is a sectional view of a bracket, etc., according to Embodiment 1 of the present invention.

Fig. 6 shows how to assemble a cooling module according to Embodiment 1 of the present invention.

Figs. 7A, 7B and 7C are three different views of a significant component of a cooling module according to Embodiment 2 of the present invention.

Figs. 8A, 8B and 8C are three different views of a significant component of a cooling module according to Embodiment 3 of the present invention.

Figs. 9A, 9B and 9C are three different views of a significant component of a cooling module according to Embodiment 4 of the present invention.

Figs. 10A, 10B and 10C are three different views of a significant component of a cooling module according to Embodiment 5 of the present invention.

Fig. 11 is a front view of a bracket according to Embodiment 6 of the present invention.

Fig. 12 is a perspective view of a cooling module, according to Embodiment 7 of the present invention, viewed from the upstream side of an air flow.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Embodiment 1)

According to the present embodiment, a heat exchanger module of the present invention is applied to a cooling module in which a radiator for a vehicle, and an external heat exchanger of an air conditioner for a

vehicle, are integrated.

Fig. 1 is a perspective view of a cooling module of Embodiment 1 viewed from a downstream side of an air flow. Fig. 2 is a top view of A-part in Fig. 1. Fig. 3 is a front view of A-part in Fig. 1. Fig. 4 is a front view of a bracket 3.

A radiator 1 cools cooling water due to a heat-exchange between the cooling water circulating in an engine and the air. A condenser 2 (see Fig. 2) cools and condenses high-pressure refrigerant discharged from a compressor.

The radiator 1 and the condenser 2 are substantially identical in structure. In particular, as shown in Fig. 1, the radiator 1 and the condenser 2 are each comprised of a core 1c having a plurality of tubes 1a through which fluid, i.e., cooling water in the radiator 1 or refrigerant in the condenser 2, and having fins 1b welded to external surfaces of the tubes 1a to increase a heat transfer surface area in contact with the air, having header tanks 1d which are connected to the plurality of tubes 1a at opposite ends of the plurality of tubes 1a in the longitudinal direction and which extend in a direction substantially orthogonal to the longitudinal direction of the tubes 1a, and having inserts 1e which are located at opposite ends of the core 1c and which extend parallel to the longitudinal direction of the tubes 1a to reinforce the core 1c, etc. According to the present embodiment, all of the above components, being made of aluminum alloy, are integrated by solder-brazing.

The condenser 2 is not shown in Fig. 1 and, hence, numerals are assigned to the tubes, the fins, the core, the header tanks and the inserts of the radiator 1, only.

"Solder-brazing", as described in "Connection·Cementation Technology" (published by Tokyo Denki University Press), refers to bonding by means of braze or solder, without fusing a base material. The bonding using a filler metal, called a brazing material,

whose fusing point is not less than 450°C is referred to as brazing. The bonding by the use of a filler, called solder, whose fusing point is not more than 450°C is referred to as soldering.

As shown in Fig. 2, the radiator 1 and the condenser 2 are arranged with core surfaces thereof being opposed to each other with a determined space. The radiator 1 and the condenser 2 are secured to brackets 3 located therebetween, are integrated with each other, and are mounted to a vehicle body through the brackets 3.

As shown in Fig. 4, the bracket 3 has the bracket body 3a in the form of a strip plate extending in the upward and downward direction at the portion between the header tank 1d of the radiator 1 and the header tank 2d (see Fig. 2), that is, the portion corresponding to the ends of the radiator 1 and the condenser 2, the mounting parts 3b for mounting the radiator 1 and the condenser 2, i.e., the cooling module, which are integrated through the brackets 3, to a vehicle body, and the mounting stays 3c, etc., in the form of strip plates projecting from end sides of the bracket body 3a in the longitudinal direction, in a direction substantially orthogonal to the longitudinal direction of the bracket body 3a, i.e., toward core sides of the radiator 1 and the condenser 2, according to the present embodiment. The mounting parts 3b are provided on front end sides of the mounting stays 3c.

The mounting stays 3c are provided on their root sides with generally triangular plate shaped reinforcing parts 3d which serve as reinforcing members to resist a moment acting on the mounting stays 3c. The reinforcing parts 3d have a plurality of through holes 3e extending in a direction orthogonal to the core surfaces, i.e., in a direction of an air flow.

According to the present embodiment, the reinforcing part 3d has a truss structure, by making the shapes of the holes 3e substantially triangular, so that no

substantial reduction of the strength occurs.

The bracket body 3a extends from parts corresponding to the header tanks 1d and 2d toward sides of the cores 1c and 2c, as shown in Fig. 5.

According to the present embodiment, the bracket bodies 3a, the mounting parts 3b, the mounting stays 3c and the reinforcing parts 3d are integrally molded by means of resin (e.g., glass-fiber-imbedded nylon).

At least one of the right and left brackets 3 of the cooling module (both the brackets in the present embodiment) is secured, on its upper end side, to the radiator 1 and the condenser 2 through bolts 4 which serve as a pin-shaped securing means extending in a direction orthogonal to the core surfaces, as shown in Fig. 2.

The inserts 1e and 2e are each comprised of a bottom surface and two opposite side walls raised from the bottom surface and are in the form of a channel generally of a U-shape in cross section.

As shown in Fig. 6, the lower ends of the radiator 1 and the condenser 2 are secured to the brackets 3 by fitting the projections 3g provided on the lower end sides of the brackets 3, in the substantially U-shaped recesses of the inserts 1e and 2e. The projections 3g are provided with tapered parts 3m obliquely oriented to the bracket body 3a side.

According to the present embodiment, as shown in Fig. 2, nuts 5 are embedded in the reinforcing parts 3d and are integrated with the brackets 3 when the brackets 3 are manufactured, so that the bolts 4 are inserted and fastened in the nuts 5 through bolt holes 1f and 2f provided in the inserts 1e and 2e.

The fan mounting parts 3f for mounting a fan shroud are provided integrally to the brackets 3 in the vicinity of the mounting parts 3b. The fan shroud covers the stays for mounting the fan to blow cooling air to the cooling module, the cooling module and the fan, in order

to prevent an airflow induced by the fan from detouring around the cooling module.

Next, the operation and the effect of the embodiment will be explained.

According to the present embodiment, the brackets 3 are made of resin and are located between the radiator 1 and the condenser 2 so that heat exchange between the radiator 1 and the condenser 2 can be restricted.

That is, because the temperature of the cooling water circulating in the radiator 1 is higher than that of the cooling medium circulating in the condenser 2, if the radiator 1 and the condenser 2 are integrated in close contact with each other, a heat transfer from the radiator 1 to the condenser 2 occurs, thus leading to reduction of the cooling efficiency of the condenser 2. However, according to the present embodiment, the brackets 3 made of resin, whose thermal conductivity is lower than that of a metal, are provided between the radiator 1 and the condenser 2, so that heat transfer from the radiator to the condenser 2 can be restricted and reduction of the cooling efficiency of the condenser 2 can be prevented.

A predetermined space must be provided between the core 1c of the radiator 1 and the core 2c of the condenser 2. According to the present embodiment, the radiator 1 and the condenser 2 are assembled with and secured to the brackets 3 so that the position of the condenser 2 with respect to the radiator 1 can be easily determined. Therefore, the assembling of the cooling module can be facilitated and heat exchange between the radiator 1 and the condenser 2 can be restricted, due to a predetermined space provided between the core 1c of the radiator 1 and the core 2c of the condenser 2.

Further, the mounting parts 3b for mounting the cooling module to a vehicle are provided in the brackets 3 and, thus, a dimensional difference between the upper mounting parts 3b and the lower mounting parts 3b is

within a manufacturing tolerance (manufacturing irregularity) of the brackets 3.

If the mounting parts 3b were provided in the radiator 1 or the condenser 2, a dimensional difference between the upper mounting parts 3b and the lower mounting parts 3b would be within a manufacturing tolerance (allowable manufacturing irregularity) of the radiator 1 or the condenser 2. Nevertheless, if the mounting parts 3b are provided in the brackets 3, the dimensional difference between the upper and lower mounting parts 3b becomes smaller, because the brackets 3 are resin-molded products and the radiator 1 and the condenser 2 are brazed products.

Consequently, the dimensional difference between the upper mounting parts 3b and the lower mounting parts 3b can be made smaller so that the mounting operation of the cooling module to a vehicle can be facilitated.

The reinforcing parts 3d have through-holes 3e extending in a direction orthogonal to the core surfaces of the core 1c and the core 2c. As the holes 3e permit the cooling air to pass therethrough, the reinforcing parts 3d, which would otherwise obstruct the cooling air flowing through the cores 1c and 2c, can enhance the rigidity of the brackets 3 without reducing the cooling efficiency of the cooling module.

According to the present embodiment, the radiator 1 and the condenser 2 are integrated through the brackets 3 and the brackets 3 are provided on opposite end sides of the both heat exchangers. If the radiator 1 is different in size from the condenser 2, both the radiator 1 and the condenser 2 may not be mounted to the brackets 3.

However, according to the present embodiment, the radiator 1 and the condenser 2 are secured to the brackets 3 through the bolts 4 extending in a direction orthogonal to the core surfaces. If holes in which the bolts 4 are inserted are larger than the diameters of the bolts 4 or are elongated holes, a dimensional difference

between the radiator 1 and the condenser 2 can be easily absorbed, so that the radiator 1 and the condenser 2 can be easily mounted to the brackets 3.

As the fan mounting parts 3f are provided in the vicinity of the mounting parts 3b, the heat exchangers 1 and 2 are free from the weight of the fan and the fan shroud.

According to the present embodiment, as the bracket bodies 3a extend from portions corresponding to the header tanks 1d and 2d to the cores 1c and 2c, it is possible to provide the bracket bodies 3a with reinforcing flanges 3k, so that the bracket bodies 3a generally exhibit a T-shape in cross section as shown in Fig. 5. Consequently, the flexural rigidity and the buckling strength of the bracket bodies 3a can be increased.

As the tubes 1a and 2a have widths (distance between parallel parts in the air flow direction) which are normally smaller than those of the header tanks 1d and 2d, the flanges 3k can be arranged on the cores 1c and 2c sides.

(Embodiment 2)

Though the radiator 1 and the condenser 2 are secured to the brackets 3 through the bolts 4 extending in a direction orthogonal to the core surfaces in Embodiment 1, according to the present embodiment, as shown in Figs. 7A-7C, the condenser 2 is secured to the brackets 3 through the bolts 4' extending parallel to the core surfaces.

The bracket bodies 3a are provided with stays 3j for fastening the condenser 2.

(Embodiment 3)

According to the present embodiment, as shown in Figs. 8A-8C, the mounting stays 1f provided on the radiator 1 are united to the stays 3j, and both the radiator 1 and the condenser 2 are secured by fastening the bolts 4'.

(Embodiment 4)

According to the present embodiment, as shown in Figs. 9A-9C, the radiator 1 and the condenser 2 are secured to the brackets 3 through the bolts 4' extending parallel to the core surfaces.

(Embodiment 5)

According to the present embodiment, as shown in Figs. 10A-10C, the fan mounting parts 3f are provided on corresponding portions of the brackets 3 at the ends of the header tanks 1d and 2d in the longitudinal direction.

(Embodiment 6)

According to the present embodiment, as shown in Fig. 11, the mounting parts 3b are provided on the brackets 3 at their parts corresponding to the ends in the longitudinal direction of the header tanks 1d and 2d.

(Embodiment 7)

Though the heat exchangers 1 and 2 are secured to the brackets 3 through the bolts in the above embodiments, according to the present embodiment, as shown in Fig. 12, the heat exchanger (the condenser 2 in Fig. 12) is secured to the brackets 3 through snap-fits 3h.

The snap-fits constitute a means for detachably securing two members, due to an elastic deformation of projections in the form of hook-shaped pins.

(Other Embodiments)

In the above embodiments, the bracket bodies 3a are provided between the header tanks 1d and 2d but the present invention is not limited thereto.

In the above embodiments, the heat exchanger modules are comprised of the radiator and the condenser, but the present invention is not limited thereto and may be applied to a module comprised of other heat exchangers.

While the invention has been described by reference to specific embodiments chosen for purposes of illustration, it should be apparent that numerous modifications could be made thereto by those skilled in

the art without departing from the basic concept and scope of the invention.